

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of claims:**

Claim 1-31

Claim 32 (new): A battery capacity calculating method for calculating a residual capacity and/or residual power of a secondary battery, comprising:

calculating an equilibrium voltage curve  $C_{\text{equ}}$  showing a relation between a discharged capacity and an equilibrium voltage in said secondary battery;

measuring a terminal voltage  $V_{\text{mea}}$  and a current value  $I$  of said secondary battery at a time of discharging;

calculating a discharged capacity  $Q_{\text{mea}}$  of said secondary battery based on the terminal voltage  $V_{\text{mea}}$  and the current value  $I$ ;

calculating an apparent equilibrium voltage  $V_{\text{ocv}}$  by adding a voltage drop  $\Delta V_{\text{dc}}$  by a direct current resistance  $R_{\text{dc}}$  to the terminal voltage  $V_{\text{mea}}$ ;

calculating an apparent discharged capacity  $Q_{\text{ocv}}$  corresponding to the apparent equilibrium voltage  $V_{\text{ocv}}$  calculated based on the equilibrium voltage curve  $Q_{\text{equ}}$ ;

calculating a capacity shift  $\Delta Q$  being a difference between the discharged capacity  $Q_{\text{mea}}$  and the apparent discharged capacity  $Q_{\text{ocv}}$ ; and

estimating a discharge curve  $C_{\text{pre}}$  in a future based on the capacity shift  $\Delta Q$  calculated at said capacity shift calculating step.

Claim 33 (new): The battery capacity calculating method according to claim 32, wherein when a state of said battery is close to the last stage of discharging, a reduction rate  $dQ$  of a capacity shift to a discharged capacity is calculated based on the discharged capacity  $Q_{\text{mea}}$  and the capacity shift  $\Delta Q$ , and the discharge curve  $C_{\text{pre}}$  in the future is estimated based on the capacity shift  $\Delta Q$  and the reduction rate  $dQ$ .

Claim 34 (new): The battery capacity calculating method according to claim 33, wherein the capacity shift  $\Delta Q$  is expressed by a linear function of the discharged capacity  $Q_{\text{mea}}$  when the state of said battery is close to the last stage of discharging.

Claim 35 (new): The battery capacity calculating method according to claim 32, wherein when a state of said battery is not in the last stage of discharging, the equilibrium voltage  $V_{\text{equ}}$  corresponding to the discharged capacity  $Q_{\text{mea}}$  is calculated based on the equilibrium voltage curve  $C_{\text{equ}}$ , and the discharge curve  $C_{\text{pre}}$  in the future is estimated based on the voltage drop  $\Delta V$  being the difference between the equilibrium voltage  $V_{\text{equ}}$  and the terminal voltage  $V_{\text{mea}}$ .

Claim 36 (new): The battery capacity calculating method according to claim 35, wherein the discharge curve  $C_{\text{pre}}$  is estimated by subtracting the voltage drop  $\Delta V$  from the equilibrium voltage curve  $C_{\text{equ}}$ .

Claim 37 (new): The battery capacity calculating method according to claim 35, wherein the discharge curve  $C_{\text{pre}}$  is estimated using a maximum voltage drop  $\Delta V_{\text{max}}$  corresponding to a maximum load by present in place of the voltage drop  $\Delta V$ .

Claim 38 (new): The battery capacity calculating method according to claim 32, further comprising calculating the residual capacity and/or the residual power of said secondary battery based on the discharge curve  $C_{\text{pre}}$ .

Claim 39 (new): The battery capacity calculating method according to claim 32, further comprising performing a judgment whether a state of said battery is near the last stage of discharging or not based on the apparent equilibrium voltage  $V_{\text{ocv}}$  to switch an estimating method of the discharge curve  $C_{\text{pre}}$  according to a judgment result.

Claim 40 (new): The battery capacity calculating method according to claim 39, wherein the apparent equilibrium voltage  $V_{ocv}$  is compared with a predetermined threshold value to perform the judgment whether the state of said battery is near the last stage of discharging or not.

Claim 41 (new): The battery capacity calculating method according to claim 32, wherein the direct current resistance  $R_{dc}$  is calculated based on voltage changes according to current changes.

Claim 42 (new): The battery capacity calculating method according to claim 32, wherein the direct current resistance  $R_{dc}$  is calculated based on an average voltage and an average current value.

Claim 43 (new): The battery capacity calculating method according to claim 32, wherein the equilibrium voltage curve  $C_{equ}$  is calculated based on equilibrium voltages at least two points and a capacity between the equilibrium voltages.

Claim 44 (new): The battery capacity calculating method according to claim 43, wherein a shrinkage ratio  $S$  expressed by a quotient obtained by dividing a fully charged capacity of the secondary battery by a fully charged capacity of an initial battery which is not deteriorated based on the equilibrium voltages at the at least two points and a capacity between the equilibrium voltages.

Claim 45 (new): The battery capacity calculating method according to claim 32, wherein charging is compulsorily stopped and an equilibrium voltage is obtained based on a subsequent voltage change.

Claim 46 (new): The battery capacity calculating method according to claim 32, wherein the calculated residual capacity and/or the calculated residual

power are transmitted to an electronic apparatus using said secondary battery as its power supply.

Claim 47 (new): A battery capacity calculating apparatus for calculating a residual capacity and/or residual power of a secondary battery, comprising:

voltage measuring means for measuring a terminal voltage  $V_{\text{mea}}$  of said secondary battery at a time of discharging;

current measuring means for measuring a current value  $I$  of said secondary battery at the time of discharging; and

operation processing means for calculating the residual capacity and/or the residual power of said secondary battery,

wherein said operation processing means calculates an equilibrium voltage curve  $C_{\text{equ}}$  showing a relation between a discharged capacity and an equilibrium voltage in said secondary battery, calculates a discharged capacity  $Q_{\text{mea}}$  of said secondary battery based on the terminal voltage  $V_{\text{mea}}$  measured with said voltage measuring means and the current value  $I$  measured with said current measuring means, calculates an apparent equilibrium voltage  $V_{\text{ocv}}$  by adding a voltage drop  $\Delta V_{\text{dc}}$  by a direct current resistance  $R_{\text{dc}}$  to the terminal voltage  $V_{\text{mea}}$ , calculates an apparent discharged capacity  $Q_{\text{ocv}}$  corresponding to the apparent equilibrium voltage  $V_{\text{ocv}}$  based on the equilibrium voltage curve  $Q_{\text{equ}}$ , calculates a capacity shift  $\Delta Q$  being a difference between the discharged capacity  $Q_{\text{mea}}$  and the apparent discharged capacity  $Q_{\text{ocv}}$ , and estimates a discharge curve  $C_{\text{pre}}$  in a future based on the capacity shift  $\Delta Q$ .

Claim 48 (new): The battery capacity calculating apparatus according to claim 47, wherein, when a state of said battery is close to the last stage of discharging, said operation processing means calculates a reduction rate  $dQ$  of a capacity shift to a discharged capacity based on the discharged capacity  $Q_{\text{mea}}$  and the capacity shift  $\Delta Q$ , and estimates the discharge curve  $C_{\text{pre}}$  in the future based on the capacity shift  $\Delta Q$  and the reduction rate  $dQ$ .

Claim 49 (new): The battery capacity calculating apparatus according to claim 48, wherein the capacity shift  $\Delta Q$  is expressed by a linear function of the discharged capacity  $Q_{\text{mea}}$  when the state of said battery is close to the last stage of discharging.

Claim 50 (new): The battery capacity calculating apparatus according to claim 47, wherein, when a state of said battery is not in the last stage of discharging, said operation processing means calculates the equilibrium voltage  $V_{\text{equ}}$  corresponding to the discharged capacity  $Q_{\text{mea}}$  based on the equilibrium voltage curve  $C_{\text{equ}}$ , and estimates the discharge curve  $C_{\text{pre}}$  in the future based on the voltage drop  $\Delta V$  being the difference between the equilibrium voltage  $V_{\text{equ}}$  and the terminal voltage  $V_{\text{mea}}$ .

Claim 51 (new): The battery capacity calculating apparatus according to claim 50, wherein said operation processing means estimates the discharge curve  $C_{\text{pre}}$  by subtracting the voltage drop  $\Delta V$  from the equilibrium voltage curve  $C_{\text{equ}}$ .

Claim 52 (new): The battery capacity calculating apparatus according to claim 50, wherein said operation processing means estimates the discharge curve  $C_{\text{pre}}$  using a maximum voltage drop  $\Delta V_{\text{max}}$  corresponding to a maximum load by present in place of the voltage drop  $\Delta V$ .

Claim 53 (new): The battery capacity calculating apparatus according to claim 47, wherein said operation processing means calculates a residual capacity and/or the residual power of said secondary battery based on the estimated discharge curve  $C_{\text{pre}}$ .

Claim 54 (new): The battery capacity calculating apparatus according to claim 47, wherein said operation processing means performs a judgment whether a state of said battery is near the last stage of discharging or not based on the

apparent equilibrium voltage  $V_{ocv}$  to switch an estimating method of the discharge curve  $C_{pre}$  according to a judgment result.

Claim 55 (new): The battery capacity calculating apparatus according to claim 54, wherein said operation processing means compares the apparent equilibrium voltage  $V_{ocv}$  with a predetermined threshold value to perform the judgment whether the state of said battery is near the last stage of discharging or not.

Claim 56 (new): The battery capacity calculating apparatus according to claim 47, wherein said operation processing means calculates the direct current resistance  $R_{dc}$  based on voltage changes according to current changes.

Claim 57 (new): The battery capacity calculating apparatus according to claim 47, wherein said operation processing means calculates the direct current resistance  $R_{dc}$  based on an average voltage and an average current value.

Claim 58 (new): The battery capacity calculating apparatus according to claim 47, wherein said operation processing means calculates the equilibrium voltage curve  $C_{equ}$  based on equilibrium voltages at least two points and a capacity between the equilibrium voltages.

Claim 59 (new): The battery capacity calculating apparatus according to claim 58, wherein said operation processing means calculates a shrinkage ratio  $S$  expressed by a quotient obtained by dividing a fully charged capacity of said secondary battery by a fully charged capacity of an initial battery which is not deteriorated based on the equilibrium voltages at the at least two points and a capacity between the equilibrium voltages.

Claim 60 (new): The battery capacity calculating apparatus according to claim 47, wherein said operation processing means compulsorily stops charging and obtains an equilibrium voltage based on a subsequent voltage change.

Claim 61 (new): The battery capacity calculating apparatus according to claim 47, further comprising transmitting means for transmitting the residual capacity and/or the residual power calculated by said operation processing means to an electronic apparatus using said secondary battery as its power supply.

Claim 62 (new): A battery capacity calculating program capable of being executed by a computer for calculating a residual capacity and/or residual power of a secondary battery, comprising:

equilibrium voltage curve calculating processing for calculating an equilibrium voltage curve  $C_{\text{equ}}$  showing a relation between a discharged capacity and an equilibrium voltage of said secondary battery;

voltage current measuring processing for measuring a terminal voltage  $V_{\text{mea}}$  and a current value  $I$  of said secondary battery at a time of discharging;

discharged capacity calculating processing for calculating a discharged capacity  $Q_{\text{mea}}$  of said secondary battery based on the terminal voltage  $V_{\text{mea}}$  and the current value  $I$ , both measured by said voltage current measuring processing;

apparent equilibrium voltage calculating processing for calculating an apparent equilibrium voltage  $V_{\text{ocd}}$  by adding a voltage drop  $\Delta V_{\text{dc}}$  by a direct current resistance  $R_{\text{dc}}$  to the terminal voltage  $V_{\text{mea}}$ ;

apparent discharged capacity calculating processing for calculating an apparent discharged capacity  $Q_{\text{ocv}}$  corresponding to the apparent equilibrium voltage  $V_{\text{ocv}}$  calculated by said equilibrium voltage calculating processing based on said equilibrium voltage curve  $C_{\text{equ}}$  calculated by said equilibrium voltage curve calculating processing;

capacity shift calculating processing for calculating a capacity shift  $\Delta Q$  being a difference between the discharged capacity  $Q_{\text{mea}}$  and the apparent discharged capacity  $Q_{\text{ocv}}$ ; and

estimating processing for estimating a discharge curve  $C_{pre}$  in a future based on the capacity shift  $\Delta Q$  calculated by said capacity shift calculating processing.